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# U.S. Army Corps of Engineers Fort Worth District

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*Final*

Lake Belton Perchlorate Bioreduction  
Bench-Scale Study  
Field Sampling Plan

**Bosque and Leon River Watersheds Study**

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US Army Corps  
of Engineers  
Fort Worth District



**MWH**  
MONTGOMERY WATSON HARZA

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## ACRONYMS

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BRA	Brazos River Authority
°C	degrees Celsius
CQC	contractor quality control
CSM	conceptual site model
DQCR	Daily Quality Control Report
DQOs	data quality objectives
FSP	field sampling plan
GPS	global positioning system
HTRW	Hazardous, Toxic, and Radioactive Waste
IDW	investigation-derived waste
MWH	MWH Americas, Inc.
NWIRP	Naval Weapons Industrial Reserve Plant
PPE	personal protective equipment
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
SAP	sampling and analysis plan
SSHP	site safety and health plan
USACE	U.S. Army Corps of Engineers Fort Worth District
USEPA	U.S. Environmental Protection Agency

## 1.0 INTRODUCTION

This *Lake Belton Perchlorate Bioreduction Bench-Scale Study Field Sampling Plan* (FSP) is a component of the *Sampling and Analysis Plan - Bosque and Leon River Watersheds Study* (SAP; MWH Americas, Inc. 2002a). The SAP includes a quality assurance project plan (QAPP), a site safety and health plan (SSHP), and task-specific FSPs. This and other task-specific FSPs are prepared as addenda to the overall SAP to describe the project requirements for the field investigations associated with the Bosque and Leon River Watersheds Study.

This FSP was prepared for the U.S. Army Corps of Engineers Fort Worth District (USACE) by its environmental contractor, MWH Americas, Inc. (MWH), through authorization provided in contract DACW57-97-D-004, Task Order DY01, Modification No. 003. This FSP has been prepared in accordance with the USACE Statement of Work dated May 7, 2002, and the *Requirements for the Preparation of Sampling and Analysis Plans* (EM 200-1-3; USACE, 2001).

### 1.1 PROJECT DESCRIPTION AND BACKGROUND

The purpose of the USACE Bosque and Leon River Watersheds Study is to assess the impact of perchlorate releases associated with the former Naval Weapons Industrial Reserve Plant at McGregor, Texas (NWIRP McGregor). Specifically, the USACE study is assessing the impact of perchlorate releases on Lake Belton and Lake Waco water quality, and the potential human and environmental exposure to perchlorate in the Lake Belton and Lake Waco study area. NWIRP McGregor is located approximately 20 miles southwest of Waco, Texas, as shown on Figure 1-1.

A conceptual site model (CSM) was prepared to provide a preliminary conceptual understanding of potential human and environmental exposures to perchlorate in the Lake Belton and Lake Waco study area (MWH, 2002b). The CSM identified data gaps in the current understanding of perchlorate migration and exposure within the study area, and identified additional investigation activities aimed at filling the data gaps. A Lake Belton perchlorate bioreduction bench-scale study is one component of the investigation activities proposed to fill certain data gaps identified in the CSM. This FSP presents the methods and procedures for collecting the lake water and sediment samples that will be used during the bench-scale study. The actual bench-scale study will be performed by the MWH Applied Research Department. Details regarding how the bench-scale study will be performed are included in Appendix A.

Please refer to the SAP for a historical summary of NWIRP McGregor, a description of the integrated multi-disciplinary project team, a description of the USACE perchlorate study area, the environmental setting, and a brief summary of previous environmental investigations in the study area. Details regarding the historical use and investigation

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history at former NWIRP McGregor also are included in the *Final Conceptual Site Model Bosque and Leon River Watersheds Study* (MWH, 2002b).

## **1.2 FIELD SAMPLING PLAN SCOPE AND OBJECTIVES**

This FSP describes the field activities to be performed and defines the procedures and methods to be used to collect field measurements and samples that will be used during the Lake Belton perchlorate bioreduction bench-scale study. Details of how the perchlorate reduction bench-scale study will be performed are included in Appendix A. The elements of the field sampling program include:

- Collecting lake water and sediment samples from the deepest portions of Lake Belton that likely have been under anoxic conditions for the longest period of time. As described in Appendix A, the rates of biological reduction of perchlorate are higher in oxygen-deficient environments.
- Collecting lake water and sediment samples from shallower portions of Lake Belton where the thermocline is close to the water/sediment interface. These “close-to-thermocline” sampling locations are included to assess natural variability within the water column.

Please note that during the course of the Bosque and Leon River Watersheds Study, the project team may determine that additional lake water and sediment samples are required to supplement the data obtained during the perchlorate bioreduction bench-scale study. Should supplemental samples be necessary, the procedures and protocols described in this FSP will be repeated.

## **1.3 DOCUMENT ORGANIZATION**

The remainder of this FSP consists of:

- Section 2.0 Field Program. Includes the rationale and data quality objectives (DQOs), sampling equipment and procedures, and all other operations associated with the field sampling program.
- Section 3.0 Health and Safety Program. References the site-specific SSHP component of the SAP. It includes all personal protective equipment (PPE) and safety precautions applicable to the field activities described in this FSP.
- Section 4.0 Quality Control. Includes the quality control that is specific to this field program including field quality assurance/quality control (QA/QC) samples and data validation requirements.

Please note that as described above, the SAP (MWH, 2002a) includes the project-specific QAPP and SSHP that should be referenced for quality assurance and health and safety procedures as they relate to the overall study.

## **2.0 FIELD PROGRAM**

This section describes the rationale and DQOs; field documentation procedures; and locations, rationale, equipment, and procedures for collecting the samples that will be used during the Lake Belton perchlorate bioreduction bench-scale study. Details of how the perchlorate reduction bench-scale study will be performed are included in Appendix A.

### **2.1 QUALITY ASSURANCE PROJECT PLAN**

All data for this project will be collected in accordance with the QAPP, which along with the SSHP and this FSP, is a component of the SAP (MWH, 2002a). The QAPP presents the QA/QC protocols that will be used to meet the DQOs of this field program. The QAPP will be referenced throughout this document to support the sampling techniques and data collection procedures presented herein. The types of data to be collected during this field program and their intended uses are presented in Table 2-1.

### **2.2 DATA QUALITY OBJECTIVES**

The primary DQO for this field program is to collect representative lake water and sediment samples from Lake Belton for the perchlorate bioreduction bench-scale study that is described in Appendix A. The procedures and protocols described herein are designed to obtain samples that are representative of the anoxic conditions that are expected to occur at various depths and locations within the lake. As described in Appendix A, the rates of biological reduction of perchlorate are higher in oxygen-deficient environments.

### **2.3 FIELD DOCUMENTATION**

All information pertinent to the field activities described herein will be entered directly into a field logbook and on project-specific field forms. The field logbook will be maintained throughout all field activities and will consist of a weatherproof, bound, survey-type book, with non-removable, numbered pages.

All data generated during the investigation and any deviations from this work plan will be recorded in detail in the field logbook. At a minimum, the date, weather conditions, personnel on site, type of activities being performed, samples collected, and any unusual conditions encountered during the investigation will be recorded in the logbook. Corrections to erroneous data will be made by crossing a single line through the entry and entering the correct information. Unused portions of the logbook pages will be crossed out, signed, and dated at the end of each work day. Language used will be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded; however, they must be clearly indicated as such and should only relate to the subject observation. The field forms that are applicable to this project include Daily

Quality Control Reports, Tailgate Safety Meeting Forms, and Chain-of-Custody Records. Field forms will become part of the project record. Sample field forms are provided in Appendix B of this work plan.

In addition to written records, photographs also will be taken as necessary to supplement written descriptions of field activities entered in the field logbook and on field forms. Photographs will be included in project reports when appropriate, and will be stored with the permanent project files.

## **2.4 LAKE WATER AND SEDIMENT SAMPLING**

This section describes the locations and rationale, equipment and procedures, and sample frequency, designation, and analysis for the lake water and sediment samples to be collected during this field program. Samples will be collected during the summer (e.g., during July or August) when the lake likely is thermally stratified and when anoxic conditions are expected to occur near the lake bottom and below the thermocline.

### **2.4.1 Locations and Rationale**

The lake water and sediment sample locations are based on the requirements of the *Perchlorate Bioreduction in Lake Belton Bench-Scale Study – Scope of Work* presented in Appendix A. Samples will be collected from three locations at the deepest portions of Lake Belton, which are likely to have been under anoxic conditions for the longest period of time, and from three shallower portions of Lake Belton where the thermocline is close to the water/sediment interface (i.e., where the water/sediment interface is 1 meter [ $\pm$  0.5 meter] below the thermocline). The proposed deep and shallow sampling locations are shown on Figure 2-1 and are based on Lake Belton bathymetric data provided by the USACE and the typical depth to the bottom of the thermocline (approximately 60 feet) referenced in the CSM (MWH, 2002b). The survey coordinates of the proposed sampling locations and a summary of the samples to be collected at each location are presented in Table 2-2.

The field team may be required to alter the three shallow sampling locations based on the thermal profile of the lake at the time of sampling. For example, if a thermocline is not detected at a proposed shallow sampling location, the field team will move to progressively deeper water until it is established that a thermocline exists 1 meter ( $\pm$  0.5 meter) above the lake bottom. Likewise, if the lake bottom is greater than 1.5 meters below the thermocline at a proposed shallow sampling location, the field team will move to progressively shallower water until it is established that a thermocline exists 1 meter ( $\pm$  0.5 meter) above the lake bottom. The procedures for determining the location of the thermocline are presented in Section 2.4.2. In the event a thermocline is not detected at the time of sampling, Thomas Gillogly (MWH Applied Research Department) will be consulted as to whether samples should be collected at the shallow locations. The field team will document the actual global positioning system (GPS) coordinates of the actual sampling locations as described in Section 2.8.

### **2.4.2 Field Observations/Measurements**

The following field observations and water quality measurements will be collected at each sampling location and recorded in the field logbook:

Field Observations:

- Air temperature
- Wind speed and direction
- Water color
- Aquatic vegetation in percent cover (qualitative)
- Cloud cover (qualitative)

Water Quality Measurements:

- Secchi Disk transparency
- Temperature (measured every 5 feet to the lake bottom)
- Dissolved oxygen (measured every 5 feet to the bottom of the thermocline)
- pH (measured every 5 feet to the bottom of the thermocline)

### **2.4.3 Identification of Thermocline**

As described in Section 2.4.1, sample depths will be determined based on the location of the thermocline. At each sampling location, temperature profiles will be established prior to collecting the samples. A thermometer or multi-parameter instrument (e.g., Hydrolab, Horiba, YSI) will be lowered through the water column in order to develop the vertical temperature profile. The selected water quality meter will be calibrated daily according to the manufacturer's instructions. The thermometer will have a minimum of 120 feet of cable to reach the deepest anticipated lake bottom at the proposed sampling locations. The temperature data will be collected at 5-foot increments from the lake surface to the lake bottom and will be recorded directly onto a copy of the Depth Profile Graph provided in Appendix B. The completed graph will be compared with Figure 2-2, which shows a thermal profile typical of a thermally stratified lake.

### **2.4.4 Lake Water Sampling Equipment and Procedures**

Once the appropriate sample depths have been established based on the location of the thermocline, the water samples will be collected with either a submersible pump or a thief sampler as described below. A summary of the lake water samples scheduled for collection is presented in Table 2-2.

**Submersible Pump Sampling Procedures.** Suitable types of submersible pumps include the Grundfos Redi-Flo2, Fultz SP-300, Keck SP-84, Bennett 140 or 180. The selected pump will be equipped with, or connected in-line to, an antibacksiphon device (Teflon wetted parts). The pump discharge shall be Teflon-lined polyethylene tubing.

After setting the pump intake at the appropriate sampling depth, the pump will be turned on and a volume of water equal to three times the volume of the discharge tubing will be purged in order to yield water that is representative of the selected sample depth. During purging, the discharge tubing above the lake surface will be inspected for air bubbles, which would indicate the tubing is not securely attached to the pump. If air bubbles are observed, the tubing will be re-attached to the pump and the purging process repeated prior to collecting the water sample. Immediately prior to collecting the lake water sample, the pH, dissolved oxygen, and temperature of the water discharging from the pump will be measured using the multi-parameter instrument described above and recorded in the field logbook.

After purging a volume of water equal to three times the volume of the discharge tubing, the lake water samples will be collected by placing the end of the discharge tubing in the bottom of the sample bottle to displace the air in the bottle as it fills with water. The sample bottle will be allowed to overflow with several container volumes to displace the water that came into contact with oxygen when the bottle initially fills. After the bottle has been allowed to overflow for approximately one minute, the discharge line will be slowly withdrawn while the water is still flowing. The sample bottle will be quickly sealed and inspected to ensure the sample has no headspace or air bubbles. If air bubbles are observed in the sealed sample bottle, the entire sample will be discarded and a new sample will be collected. Table 2-3 contains a summary of the required sample containers. The samples will be labeled, handled, and shipped according to the procedures described in Section 2.5. The submersible pump and discharge tubing will be decontaminated according to the procedures described in Section 2.6.

**Thief Sampler Procedures.** Suitable types of thief samplers include Kemmerer, Van Dorn, Alpha, or a double check-valve bailer. Thief samplers consist of a cylinder with stoppers or check valves on each end. These samplers allow water to pass through the sample cylinder as it is lowered to the desired sampling depth. The samplers then are activated to close the stoppers and retain the sample prior to retrieval. The Kemmerer, Van Dorn, and Alpha samplers are activated by sending a “messenger” down the retrieval line to close the stoppers. The double check-valve bailer is activated by raising the bailer, which forces the check valves at each end of the cylinder to close. Schematics of typical thief samplers are shown on Figure 2-3. The selected thief sampler will be raised and lowered with a spooled stainless-steel cable either by hand or using a boat-mounted winch. The stainless-steel cable will be marked or the spool will be metered such that the sampled depth can be accurately measured.

Upon retrieval of the sampler, the sample will be transferred to the appropriate sample containers. If a Kemmerer, Van Dorn, or Alpha sampler is used, one of the stoppers will

be opened and the sample carefully poured into the sample container. If a bailer is used, the sample will be transferred to the sample container using the discharge port. The sample bottle will be quickly sealed and inspected to ensure the sample has no headspace or air bubbles. If air bubbles are observed in the sealed sample bottle, the entire sample will be discarded and a new sample will be collected. Table 2-3 contains a summary of the required sample containers. The samples will be labeled, handled, and shipped according to the procedures described in Section 2.5. The thief sampler and stainless-steel cable will be decontaminated according to the procedures described in Section 2.6.

#### **2.4.5 Sediment Sampling Equipment and Procedures**

Sediment samples will be collected using either a dredge or a gravity corer as described below. The dredge or the gravity corer will be raised and lowered with a stainless-steel cable attached to a boat-mounted winch. The stainless-steel cable will be marked or the spool will be metered such that the sampled depth can be accurately measured. The procedures for collecting sediment samples with a dredge and a gravity corer are presented below. A summary of the sediment samples scheduled for collection is presented in Table 2-2. Please note that at locations where both sediment and lake water samples will be collected, the lake water samples should be collected prior to collecting the sediment samples to prevent disturbed sediments from contaminating the lake water samples.

**Dredge Sampling Procedures.** Dredges (e.g., Peterson, Eckman, Ponar, Van Veen) generally consist of a clam shell arrangement of two buckets (refer to Figure 2-4). The buckets either may close upon impact with the lake bottom or be activated by sending a “messenger” down the retrieval line to close the buckets. Upon retrieval, the sediments are transferred from the dredge to the appropriate sample container.

When using a dredge, a sample container will be prepared prior to retrieving the sediment sample in order to create an inert environment for the sample. Table 2-3 contains a summary of the required sample containers. The sample container will be filled with water collected from within 1 meter of the water/sediment interface (i.e., the lake bottom) following the lake water sampling procedures described above (i.e., with a submersible pump or a thief sampler). Once the container has been filled with representative water and sealed, the sediment sample can be retrieved.

Upon retrieval of the dredge, the sample container will be opened and the sediment placed in the container. This process should occur as quickly as possible to minimize the time that the sediment and water in the sample container are exposed to air. If necessary, the sample container will be topped-off with water obtained from near the lake bottom and capped so there is no headspace and no air bubbles in the container. The contents of the sealed jar should be inspected to ensure that no large debris are present that would account for more than 20 percent of the sample volume (e.g., rocks, vegetation) and that the contents are headspace free. If the sample container is not headspace free or if large debris are present, the entire sampling process must be repeated after completely rinsing

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the sample jar with lake water. The samples will be labeled, handled, and shipped according to the procedures described in Section 2.5. The dredge and stainless-steel cable will be decontaminated according to the procedures described in Section 2.6.

**Gravity Corer Sampling Procedures.** Gravity corers are generally constructed of an outer rigid metal tube (core barrel) into which a polyethylene or acrylic liner fits with minimal clearance (refer to Figure 2-4). Samples are obtained by allowing the sampler, which is attached to sufficient length of stainless-steel cable, to drop to the bottom. An opening exists above the liner to allow free flow of water through the corer as it moves vertically through the water and into the sediment. The weight of the sampler drives the core barrel into the sediment to varying depths depending on the characteristics of the sediments. The sampler has a messenger-activated valve assembly that seals the opening above the liner following sediment penetration, which creates a partial vacuum to assist in sample retention during retrieval. Upon retrieval, the liner is removed, trimmed such that the sediments inside the liner are flush with the ends of the liner, and capped with a sheet of Teflon held in place by a plastic cap. The caps are secured with tape on the outside of the liner. The liner is then labeled, handled and shipped to the laboratory as described in Section 2.5. The gravity corer and stainless-steel cable will be decontaminated according to the procedures described in Section 2.6.

#### **2.4.6 Sample Frequency, Designation, and Analysis**

**Sample Frequency.** One sediment sample will be collected from each of the shallow and deep sampling locations for a total of six sediment samples. At sampling location “Shallow 1”, one lake water sample will be collected from just above the lake bottom, but below the thermocline. At sampling location “Deep 1”, three lake water samples will be collected: 1) from just below the lake surface, 2) from just below the thermocline, and 3) from just above the lake bottom. A summary of all samples that will be collected during this field program is presented in Table 2-2. Table 2-3 contains a summary of the required sample containers. Please note that each sediment and lake water sample requires multiple sample containers.

**Sample Designation.** Each sample will be designated with an alphanumeric character string set apart by hyphens. The designation will begin with the lake name abbreviation (e.g., “LB” for Lake Belton), followed by “LW” to indicate a lake water sample or SED to indicate a sediment sample, “Deep” or “Shallow” to indicate the sample was collected from the deep or shallow sampling location, and finally by the depth the sample was collected. For example, the lake water sample collected from Lake Belton sampling location “Deep 1” from 1 foot deep (e.g., just below the lake surface) would be designated “LB-LW-Deep1-1’ ”. The sediment sample collected from Lake Belton sampling location “Shallow 3” from 60 feet deep would be designated “LB-SED-Shallow3-60’ ”. The sample designations for all samples scheduled to be collected during this field program are summarized in Table 2-2.

**Sample Analysis.** All lake water and sediment samples will be manipulated (i.e., spiked, mixed, inoculated) as described in the *Perchlorate Bioreduction in Lake Belton Bench-Scale Study – Scope of Work* presented in Appendix A. After the samples have been manipulated according to the procedures described in Appendix A, aliquots of the samples will be analyzed for perchlorate by USEPA Method 314.0 at the USACE Engineer Research and Development Center Environmental Laboratory at the Environmental Chemistry Branch in Omaha, Nebraska. The USACE laboratory will conform to the analytical method requirements, analytical quality control requirements, instrument calibration frequency, and the laboratory quality control requirements presented in the QAPP. A discussion of sample labeling, chain-of-custody, handling and shipping is presented in Section 2.5.

## **2.5 SAMPLE LABELING, CHAIN-OF-CUSTODY, HANDLING, AND SHIPPING**

### **2.5.1 Sample Labeling**

A label will be placed on each sample container submitted for bench-scale testing and will include the following information:

- Project name and location
- Sample designation
- Date and time of sample collection
- Preservative (if applicable)
- Sampler's initials
- Requested analyses.

### **2.5.2 Chain-of-Custody**

A chain-of-custody form will be completed and will accompany each sample cooler submitted to the MWH Applied Research Department. This form includes project identification, project location, sample designation, and analysis type. In addition, there are spaces for entry of the sample collection date and time, signatures of the persons relinquishing and receiving samples, and the conditions of the samples upon receipt by the MWH Applied Research Department. An example chain-of-custody form is included in Appendix B.

### **2.5.3 Sample Handling and Shipping**

Immediately after sample collection, each sample container will be placed in a cooler that contains sufficient ice to maintain the samples at a temperature of  $4 \pm 2$  °C. Each sample will be placed in a reclosable polyethylene bag (e.g., Ziploc®) and wrapped separately in bubble-wrap or other protective material. Ice will be double-bagged in reclosable polyethylene bags such that the water will not fill the cooler as the ice melts. The chain-

of-custody record will be placed inside a plastic bag, sealed, and placed inside the lid of the cooler. The lake water and sediment samples can be shipped in the same cooler(s).

When all samples have been collected, the cooler(s) will be taped shut with strapping tape and custody seals shall be affixed to the outside of the cooler. All samples will be shipped to the MWH Applied Research Department within 24 hours of sample collection via Federal Express priority service (or equivalent) to ensure that the samples arrive in time to meet both analytical holding times and the project schedule. All samples will be shipped to:

Brian Gallagher  
Applied Research Department - Research Center and Fabrication Facility  
MWH  
327 West Maple Street  
Monrovia, California 91016  
626-358-2711

Mr. Gallagher will be contacted prior to initiating the sampling activities so that he will know when to expect delivery of the samples. Unless previous arrangements are made with Mr. Gallagher, samples only should be shipped on Monday, Tuesday, or Wednesday to allow sufficient time for processing at the MWH Applied Research Department.

## **2.6 EQUIPMENT DECONTAMINATION PROCEDURES**

Due to the nature of the sampling activities described in this FSP (i.e., sampling water and sediment from a lake used as a drinking water source), it is not expected that the sampling equipment will become grossly contaminated. Therefore, it will not be necessary to implement decontamination procedures that are typically necessary at a Hazardous, Toxic, and Radioactive Waste (HTRW) site (e.g., non-phosphate detergent wash, distilled water rinse, etc.) after each sample is collected. All sampling equipment will be thoroughly decontaminated at the Brazos River Authority (BRA) laboratory prior to mobilizing to collect the lake water and sediment samples. Between each use (i.e., after each sample is collected), the sampling equipment will be rinsed with lake water prior to collecting the next sample. For example, the sediment sampler (dredge or gravity corer) will be rinsed with lake water between each use until all visible sediments are removed. When using a submersible pump, the sampling procedures require that the pump and discharge tubing be purged with lake water prior to collecting the water samples at each location (refer to Section 2.4.2). After all samples have been collected, the sampling equipment will be returned to the BRA laboratory for decontamination and storage.

## **2.7 INVESTIGATION DERIVED WASTE HANDLING**

### **2.7.1 Introduction**

The types of IDW expected to be generated during this field program include personal protective equipment (PPE) and disposable field equipment. Because field decontamination of the sampling equipment will be limited to rinsing with lake water (refer to Section 2.6), no decontamination fluids will be generated. All field activities are expected to be conducted in Level D PPE (see Section 1.4 of the SSHP); therefore, the only PPE that will be discarded will be disposable work gloves. The PPE and disposable sampling equipment (e.g., paper towels, empty 5-gallon buckets, nylon rope, etc.) will be discarded as non-hazardous municipal waste.

## **2.8 GLOBAL POSITIONING SYSTEM SURVEY**

The sampling locations will be documented using a Garmin GPS 76 instrument. The accuracy of this instrument ranges from less than 3 meters to less than 15 meters depending on the sky cover and the number of satellites available at the time a reading is taken. The GPS information to be recorded at each grid point includes latitude (degrees and minutes), longitude (degrees and minutes), and the instrument accuracy information at the time each reading is recorded. The GPS information will be used for reporting purposes. It also may be necessary to return to the general vicinity of the sampled locations at a later date to perform verification sampling activities.

## **2.9 CONTRACTOR QUALITY CONTROL**

The three-phase Contractor Quality Control (CQC) program described in Section 6.0 of the SAP will be implemented when performing the activities described in this FSP. The field activities described in this FSP can be combined into a single definable feature of work (e.g., lake water and sediment sampling). The CQC program will be implemented prior to initiating this definable feature of work and will remain in effect throughout its duration.

TABLE 2-1  
SUMMARY OF DATA TYPES AND USES FOR THE LAKE BELTON PERCHLORATE BIOREDUCTION BENCH-SCALE STUDY  
FIELD SAMPLING PROGRAM

Field Program	Summary of Proposed Activities	Data	Data Type	Data Uses
Field Observations	Observations by an on-site professional during all field activities.	Date	Field	Project documentation
		Weather conditions	Field	
		On-site personnel	Field	
		Field activity type	Field	
		Samples collected/Details	Field	
		Unusual conditions encountered	Field	
pH, Temperature, and Dissolved Oxygen Measurements	pH, temperature and dissolved oxygen will be measured every 5 feet to from the lake surface to bottom.	pH	Definitive	Temperature profiles will be used to establish the depth to the bottom of the thermocline, which in turn will be used to determine the “shallow” sampling locations. As described in Section 2.4.1, the water/sediment interface must be within 1.0 meter (+ 0.5 meter) of the bottom of the thermocline at the shallow sampling locations. A surface water sample also will be collected from just below the thermocline at the “Deep 1” sampling location.  pH, temperature, and dissolved oxygen profiles will be used during interpretation and reporting of the bench-scale study results.
		Temperature	Definitive	
		Dissolved Oxygen	Definitive	
Collect Surface Water and Sediment Samples	Collect surface water and sediment samples according to the procedures described in this FSP.	Field observations and water quality measurements as described above.	Field/Definitive	Samples will be shipped to MWH Applied Research Center for perchlorate bioreduction bench-scale testing (refer to Appendix A).

Note: During summer, the thermocline is a depth region in a lake that separates the epilimnion (the shallow, warm, well-mixed region of a lake) and the hypolimnion (the deep, cold, and relatively stagnant region of a lake) and is identified by rapidly decreasing temperatures with depth (refer to Figure 2-2).

**TABLE 2-2**  
**SUMMARY OF SAMPLES TO BE COLLECTED DURING THE**  
**LAKE BELTON PERCHLORATE BIOREDUCTION BENCH-SCALE STUDY**  
**FIELD SAMPLING PROGRAM**  
**(Page 1 of 2)**

<b>Sample Designation <sup>(a)</sup></b>	<b>Sample Location/Rationale</b>	<b>Northing</b>	<b>Easting</b>
<b>LAKE WATER SAMPLES</b>			
LB-LW-Deep1-1'	Lake water sample collected from just below the surface of Lake Belton at sample location Deep 1. Obtain lake water sample for bench-scale testing.	645112.8785	3442878.547
LB-LW-Deep1-depth	Lake water sample collected from just below the thermocline in Lake Belton at sample location Deep 1. Obtain lake water sample for bench-scale testing.	645112.8785	3442878.547
LB-LW-Deep1-depth	Lake water sample collected from just above the bottom of Lake Belton at sample location Deep 1. Obtain lake water sample for bench-scale testing.	645112.8785	3442878.547
LB-LW-Shallow1-depth	Lake water sample collected from just below the thermocline in Lake Belton at sample location Shallow 1. Obtain lake water sample for bench-scale testing.	639748.1927	3446890.342

*Note that lake water samples only will be collected from the "Deep 1" and "Shallow 1" sampling locations.*

(a) Sample Designation: LB – Lake Belton SED – Sediment LW – Lake Water

(b) Sample locations Shallow 1, Shallow 2, and Shallow 3 must be located where water/sediment interface is within 1.0 meter ( $\pm$  0.5 meter) of the thermocline (refer to Section 2.4.1). Therefore, actual Northing and Easting coordinates may vary from those shown on this table. The Northing and Easting information is Universal Transverse Mercator (UTM) coordinates in Meters, Zone 14 North, North American Datum 1983 (NAD 1983)

(c) Sample depths will be measured from the lake surface.

All samples will be sent to:

Brian Gallagher  
MWH Applied Research Department - Research Center and Fabrication Facility  
327 West Maple Street  
Monrovia, California 91016  
(626) 358-2711

**TABLE 2-2**  
**SUMMARY OF SAMPLES TO BE COLLECTED DURING THE**  
**LAKE BELTON PERCHLORATE BIOREDUCTION BENCH-SCALE STUDY**  
**FIELD SAMPLING PROGRAM**  
**(Page 2 of 2)**

<b>Sample Designation</b> <sup>(a)</sup>	<b>Sample Location/Rationale</b>	<b>Northing</b>	<b>Easting</b>
<b>SEDIMENT SAMPLES</b>			
LB-SED-Deep1-depth <sup>(c)</sup>	Sediment sample collected from sample location Deep 1. Obtain sediment sample from deepest portion of Lake Belton for bench-scale testing.	645112.8785	3442878.547
LB-SED-Deep2-depth	Sediment sample collected from sample location Deep 2. Obtain sediment sample from deepest portion of Lake Belton for bench-scale testing.	641557.241	3444797.168
LB-SED-Deep3-depth	Sediment sample collected from sample location Deep 3. Obtain sediment sample from deepest portion of Lake Belton for bench-scale testing.	645338.7807	3446050.461
LB-SED-Shallow1-depth	Sediment sample collected from sample location Shallow 1. Obtain sediment sample from just below thermocline in Lake Belton for bench-scale testing.	639748.1927	3446890.342
LB-SED-Shallow2-depth	Sediment sample collected from sample location Shallow 2. Obtain sediment sample from just below thermocline in Lake Belton for bench-scale testing.	642372.255	3447936.926
LB-SED-Shallow3-depth	Sediment sample collected from sample location Shallow 3. Obtain sediment sample from just below thermocline in Lake Belton for bench-scale testing.	645412.8214	3448655.827

(a) Sample Designation: LB – Lake Belton SED – Sediment LW – Lake Water

(b) Sample locations Shallow 1, Shallow 2, and Shallow 3 must be located where water/sediment interface is within 1.0 meter ( $\pm$  0.5 meter) of the thermocline (refer to Section 2.4.1). Therefore, actual Northing and Easting coordinates may vary from those shown on this table. The Northing and Easting information is Universal Transverse Mercator (UTM) coordinates in Meters, Zone 14 North, North American Datum 1983 (NAD 1983)

(c) Sample depths will be measured from the lake surface.

All samples will be sent to:  
 Brian Gallagher  
 MWH Applied Research Department - Research Center and Fabrication Facility  
 327 West Maple Street  
 Monrovia, California 91016  
 (626) 358-2711

TABLE 2-3

## SAMPLE CONTAINERS AND PRESERVATION REQUIREMENTS

Sample Type	Container Type	Container Size (Number)	Closure	Preservative	Holding Time
Sediment <sup>a</sup>	Amber Glass	1-liter (two per sample at all locations except Deep 1 where three are required)	Teflon-lined solid cap	None	Samples will be shipped via priority overnight courier within 24 hours of collection.
Sediment <sup>b</sup>	Polyethylene or Acrylic Liner	1-liter (two per sample at all locations except Deep 1 where three are required)	Trim liner so sediments are flush with ends of liner, cap with Teflon sheeting, and secure ends with plastic caps and tape.	None	Samples will be shipped via priority overnight courier within 24 hours of collection.
Surface Water	Amber Glass, narrow mouth	1-liter (three per sample at all locations except the bottom sample at Deep 1 where six are required)	Open top with 0.125" Teflon/silicone septa or Teflon-lined solid cap	None	Samples will be shipped via priority overnight courier within 24 hours of collection.

a Requirements for sediment samples collected with a dredge.

b Requirements for sediment samples collected with a gravity corer.

### **3.0 HEALTH AND SAFETY PROGRAM**

All personnel involved with the field activities described in this FSP shall follow the *Site Safety and Health Plan – Bosque and Leon River Watersheds Study* (SSHP; MWH, 2002a). The SSHP was prepared specifically for the field investigations that will support the USACE Bosque and Leon River Watersheds Study, and includes the health and safety procedures and protocols for the field activities described in this FSP. The Activity Hazard Analysis that is specific to collecting lake water and sediment samples for the perchlorate bioreduction bench-scale study is summarized in Table 1-1d of the SSHP.

## **4.0 QUALITY CONTROL**

This section is a summary of quality control procedures that will be followed during the this field program, including daily quality control reports, field and laboratory quality control samples, data validation, and final reporting requirements. The overall quality program for all field investigations that will be implemented to support the USACE Bosque and Leon River Watersheds Study is presented in the *Quality Assurance Project Plan – Bosque and Leon River Watersheds Study* (QAPP; MWH, 2002a).

### **4.1 DAILY QUALITY CONTROL REPORTS**

Daily Quality Control Reports (DQCRs) will be prepared for every day field work is performed. DQCRs are field reports that summarize daily activities and help project personnel track quality control activities. These reports will include location(s) of work, weather conditions, work performed, results of any inspections/tests performed, the individuals performing the inspections/tests, equipment calibration procedures, problems identified and associated corrective actions taken, any instructions received from the USACE Project Manager, and any general comments. A DQCR form is included in Appendix B.

### **4.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES**

The sampling procedures described in this FSP will provide an adequate sample volume for preparation and analysis of control samples during the bench-scale testing. Because the samples will not be used for site characterization purposes, field QA/QC samples (e.g., equipment blanks, blind duplicates, matrix spike/matrix spike duplicates) will not be collected. Details regarding how the control samples will be prepared and analyzed is presented in the *Perchlorate Bioreduction in Lake Belton Bench-Scale Study – Scope of Work* included in Appendix A.

### **4.3 LABORATORY QUALITY CONTROL**

After the samples have been manipulated by the MWH Applied Research Department (i.e., spiked, mixed, inoculated) according to the procedures described in Appendix A, aliquots of the samples will be shipped to the USACE Engineer Research and Development Center Environmental Laboratory at the Environmental Chemistry Branch in Omaha, Nebraska for perchlorate analysis by USEPA Method 314.0. All analytical procedures performed during this project will conform to the most recently promulgated version of *Method 314.0 - Determination of Perchlorate in Drinking Water Using Ion Chromatography* (USEPA, 1999). Additional information regarding the analytical method requirements is included in Section 7.0 of the QAPP.

The analytical quality control requirements (laboratory method detection limits; practical quantitation limits; summary of internal quality control procedures; control limits for matrix spikes, matrix spike duplicates, and surrogate spikes; control limits for laboratory control samples; and calibration procedures) are presented in Appendix A of the QAPP. Data management, including the format of the data packages and data archive, will follow the guidance set forth in Section 9.0 of the QAPP.

#### **4.4 DATA VALIDATION AND VERIFICATION**

All data received from the USACE Engineer Research and Development Center Environmental Laboratory will be reviewed by the MWH Project Chemist to ensure that the data meets the project data quality objectives (refer to Section 9.5 of the QAPP, Reconciliation with Data Quality Objectives). Specifically, the Project Chemist will review the holding times, relative percent differences, and blank analyses. In addition, Level IV data validation on 10 percent of the analyzed data for the samples also will be performed in accordance with *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (USEPA, 1994), the Department of Defense “*Quality Systems Manual for Environmental Laboratories*” (Version 1.0, October 2000), and the USACE EM 200-1-3, Appendix I “*Shell for Analytical Chemistry Requirements*” (February 2001). All data will be presented with explanations of nonconforming data. Resampling or reanalysis may be requested in the case of unsatisfactory performance on the part of the laboratory.

#### **4.5 REPORTING REQUIREMENTS**

Project activities will be documented in the quarterly updates regarding the data that were collected during the field sampling activities. A technical memorandum will be prepared each quarter that discusses the results and makes recommendations for refining the sampling/measurement criteria. The text will also include a discussion of field methods and procedures that deviated from those proposed in this document (if any). All laboratory analytical data will be presented with a data validation narrative that will summarize the quality and usefulness of the data.

## 5.0 REFERENCES

- Department of Defense, 2002. *Quality Systems Manual for Environmental Laboratories*. Prepared By DoD Environmental Data Quality Workgroup - Department of Navy, Lead Service. Version 1, October 2000.
- MWH Americas, Inc., 2002a. *Sampling and Analysis Plan – Bosque and Leon River Watersheds Study*; comprises the sampling and analysis plan (SAP), quality assurance project plan (QAPP), site safety and health plan (SSHP), and the task-specific field sampling plans (FSPs). Prepared for the U.S. Army Corps of Engineers, Fort Worth District. July 2002.
- MWH Americas, Inc., 2002b. *Final Conceptual Site Model – Bosque and Leon River Watersheds Study*. Prepared for the U.S. Army Corps of Engineers, Fort Worth District. April 2002.
- U.S. Army Corps of Engineers, 2001. *Requirements for the Preparation of Sampling and Analysis Plans*. EM 200-1-3.
- U.S. Environmental Protection Agency, 1994. USEPA Contact Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review, Office of Emergency and Remedial Response, Washington D.C., 1994.
- U.S. Environmental Protection Agency, 1996. *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846)*, (U.S. EPA Third edition, September 1986; Final Update I, July 1992; Final Update IIA, August 1993; Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996).
- U.S. Environmental Protection Agency, 1999. *Method 314.0 - Determination of Perchlorate in Drinking Water Using Ion Chromatography*. Revision 1.0, November 1999.